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ORIGINAL PAPERS

One and a Half Centuries of Demographic Transition in Nepal

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ABSTRACT

This paper examines the past and prospective demographic transition in Nepal. Sparse data from the pre-1961 censuses suggest that mortality decline began during 1930s and allow rough estimates of fertility and mortality levels prior to 1961. Fertility decline began sometime between 1961 and early 1980s, with the total fertility rate declining from about 6 to 5 children per woman by early 1990s. The four scenarios of future fertility decline and population growth presented in the paper help draw several conclusions. A continuation of the recent slow pace of fertility decline would result in a total population of slightly over 100 million by the end of the next century (Scenario I). More rapid decline, similar to the median experience of Asian countries, would reduce this growth to below 60 million (Scenario III). Still more rapid decline, close to the limit of what has been observed in countries that have experienced the most rapid declines, could reduce the growth to 40 million (Scenario IV). It is possible, if not at present particularly plausible, that very rapid decline might be achieved by a combination of smaller family sizes and rising age of childbearing. An approach to reaching zero population growth rapidly—and anything less than a doubling of current population—may be ruled out with a high degree of certainty (Scenario II and IV). A doubling of population to 40 million is the least possible growth that can be expected. At the current rate of fertility decline, population will increase to 100 million during this century. If a smaller population in this range is considered to be in the national interest, it is as important to work for more rapid fertility decline as it is to work for accommodation of a much larger population.

***Key words**:* Demographic transition; Population growth; Fertility decline; Nepal

INTRODUCTION

Despite an extensive literature on theories of demographic transition, there are a few studies that trace the evolution of particular transitions from beginning to the end. This is probably due mainly to dearth of information. Empirical materials *per se* are voluminous, to be sure, but the statistical record rarely covers the full extent of the transition, either because it began before the statistical record-keeping or because it is underway, or both. Developed countries fall mostly into the first category, while developing countries fall into the second or third categories.

The nearly overwhelming focus on fertility decline, which may occur relatively at a rapid pace, obscures the protracted nature of demographic transitions. Generally, if not always, the beginning of mortality decline precedes the beginning of fertility decline by many decades, and

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population growth due to the momentum of age distribution will usually continue for half a century or more after fertility decline ceases. Even the shortest demographic transitions last for at least one century.

This paper examines the past and prospective demographic transition in Nepal. The analysis builds on earlier work by Feeney *et al*. undertaken for the Ministry of Population and Environment, His Majesty's Government of Nepal (1). Sparse data from the pre-1961 censuses suggest that mortality decline began during 1930s and allow rough estimates of fertility and mortality levels prior to 1961. Fertility decline began sometime between 1961 and early 1980s, with the total fertility rate declining from about 6 to 5 children per woman by early 1990s.

Unfolding of the transition over the next century is studied by means of a few carefully-chosen scenarios. The first of these assumes a continuation of fertility decline at the relatively slow pace observed in the recent past. Fertility reaches replacement level *circa* 2050, but, because of the momentum of the young-age distribution, it takes another 50 years for the population to stabilize– at 100 million. More than five-fold increase over the 1991 census population of 18.5 million provokes investigation of alternative scenarios that show lower population growth.

The alternative scenarios invert the usual projection procedure, in which assumed age-specific birth rates determine future population growth, by directly specifying numbers of persons in future periods and deriving the implied levels of fertility. We consider what would be required for zero population growth beginning in 2001. It is shown that not only would this require an immediate fall of fertility to below one child per woman, but that it would result in tremendous fluctuations in the age distribution over the coming century.

This leads to two further scenarios in which population growth is minimized subject to the requirement of a reasonably smooth approach to zero population growth. These scenarios imply a future population of between 40 and 60 million.

MORTALITY DECLINE BEGINS: 1911-1961

Five population censuses were carried out in Nepal prior to the 1961 census, in 1911, 1920, 1930, 1941, and 1952-1954. Complete reports of the 1911, 1920, 1930 and 1941 censuses were not published, and the only results available for 1911, 1920, and 1941 are total population by sex. In the 1930 census, even the sex breakdown is missing. Little is known of how the enumerations were conducted or how reliable the figures might be. These seem to have been saved from complete obscurity only by several notes in the report of the 1952-1954 census.

The 1952-1954 census was intended to be carried out in 1951 with a reference date of May 28 (2). Due to a change-over in the political system, the enumeration was delayed and was in the end conducted in two parts. Census in the eastern portion of the country, except Mahottari district, was completed in 1952 with a reference date of 28 May. The western portion of the country and Mahottari district only were covered in 1954 with the same reference date. The reference date for the enumeration as a whole was 28 May 1953.

The census counts for 1911, 1920, and 1930 indicate the population growth rates of -0.13% for 1911-1920 and -0.08% for 1920-1930, i.e. essentially constant growth rates of slightly below zero. This suggests that fertility and mortality were approximately constant before 1930, and that the population prior to 1930 may be regarded as approximately stable with a growth rate of -0.1%.

Thus, although no information on age distribution is available from the early censuses, we may assume fertility and mortality levels consistent with a stable population growth rate of -0.1%. With a total fertility rate of 6.1 children per woman, the level estimated *circa* 1960, a growth rate of -0.1% implies a female expectation of life at birth of 20 years, the lower limit of the Coale-Demeny model life-tables (3). This very low level of life expectancy leads us to ask whether the level of fertility during 1911-1930 might have been lower than 6.1 children per woman, but the projection analysis described below suggests that the very low level of mortality is the most appropriate estimate. We may, therefore, estimate the age distribution as of 1911 as the stable distribution with growth rate of -0.1% and female expectation of life at birth of 20 years.

Given the estimates of the 1911 age distribution and levels of fertility and mortality, we may project population forward at a five-year interval through 1961, comparing (interpolated) projected numbers with available census counts. Analysis of a series of such projections yields two conclusions. First, the censuses of 1911, 1920, and 1930 under-enumerated the total population by about one-third. The basis for this conclusion is the impossibility of arriving, by any

reasonable combination of changing levels of fertility and mortality, at the 1961 population without adjusting that of 1911-1930 substantially upward.

The census counts for 1930, 1941, 1952-1954, and 1961 indicate population growth rates of 1.16%, 2.25%, and 1.14% respectively for the 1930-1941, 1941-1953, and 1953-1961 periods. These must not be taken at face value, of course, given the likelihood of substantial and varying completeness of enumeration indicated by the analysis of the counts for the 1911-1930 period. It is reasonable to assume that the level of fertility was approximately constant at 6.1 children per woman during 1911-1961, however, and that female expectation of life at birth rose linearly from 20 years for 1926-1931 to a value in the 30s for 1961-1966. This leaves us with a single free parameter—female expectation of life at birth for 1961-1966, with which to obtain the best possible fit to the early census counts. The value settled on (by considering available estimates and the fit of the projected 1961 age distribution to the 1961 census age distribution) was 35.5 years.

FERTILITY DECLINE BEGINS: 1961-1996

The most recent estimates of fertility change for Nepal come from a recent study by Retherford and Thapa (4), which applies birth-history and own-children methods to national surveys taken in 1976, 1991, and 1996, and includes a detailed analysis of errors. Our estimates of fertility for the periods 1961-1965 through 1991-1995 are computed as averages of the corresponding calendar year estimates (4).

In view of the long gap between the 1976 survey and the 1991 survey, it is uncertain when fertility decline began. In the long-term perspective offered here, the precise timing of the decline makes very little difference, and we accept the linearly-interpolated values given by Retherford and Thapa.

FOUR SCENARIOS FOR THE NEXT 100 YEARS

We now consider future population change, which represents the greater part of Nepal's demographic transition, by means of several scenarios for future fertility change. The first scenario continues the slow rate of decline observed in the recent past. It shows the total population of Nepal rising to over 100 million over the next century. The remaining scenarios consider the possibilities for slower growth. In all scenarios, female expectation of life at birth is assumed to follow the trend given in the 1998 revision of the United Nations estimates (5) through 2050 and to remain constant at this level thereafter.

Scenario I: Continued slow decline

The Retherford-Thapa estimates show total fertility declining at a rate of 0.45 children per woman per decade over the past decade. Our first scenario for future population change in Nepal assumes that this rate of decline will continue until replacement level, taken to be 2.1 children per woman, is reached and that replacement-level fertility is maintained thereafter. In this scenario, fertility reaches replacement level in 2056, by which time the total population has grown to 77 million. Sufficient population momentum remains, however, to delay population stabilization for another 50 years, during which time population rises to just below 100 million.

The rate of fertility decline in Nepal is slow compared to rates of decline in Asia generally. The median rate of decline for 21 Asian countries, based on the United Nations estimates, is one child per woman per decade, and rates as high as two children per woman per decade have been observed (6,7). It is, therefore, appropriate to consider alternative scenarios in which fertility declines more rapidly.

Scenario II: Zero population growth from 2001

As a matter of purely formal demographic arithmetic, it is always possible to achieve zero population growth immediately. For example, the number of persons aged five years and above in 2006 is, in the absence of immigration, necessarily less than total population in 2001. Reducing fertility sufficiently so that the projected number of persons (aged 0-4 year(s) in 2006) equals this difference will give zero growth for 2001-2005, and similarly for subsequent periods. This formal demographic calculation is as instructive as it is hypothetical, for it shows both that zero population growth is effectively impossible in the short-term and that it would probably be undesirable if it were possible.

Figure 1 shows the total fertility rates necessary to achieve immediate zero population growth. The rate would have to decline from 4.8 children per woman for 1996-2000 to barely over 2 children per woman for 2001-2005, followed by a further decline to as low as 0.72 child per woman for 2016-2020. Thereafter, total fertility would be required to undergo long swings up and down,

rising to a high of 3.9 children per woman for 2056-2060. Failure of total fertility rates to rise would result in a long period for population to decline.

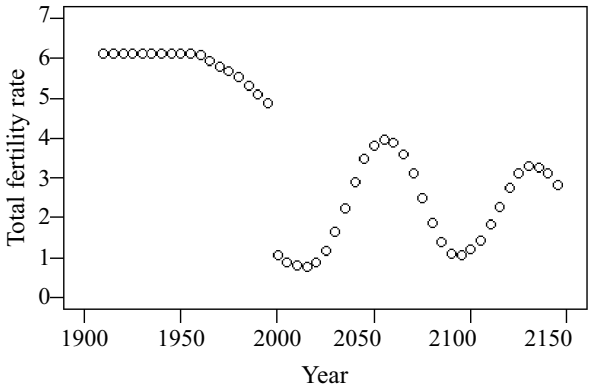

Fig. 1. Total fertility rate required to reach zero population growth in Nepal following 2001

Even under the most radically-optimistic scenario for rapid fertility decline, a decline from 5 children per woman to one child per woman over a period of only five years is clearly out of the question. Even if so rapid a decline in fertility to so low a level were possible, it would almost certainly be undesirable because of the implications for population age distribution. It should be recalled that one-child families were and are a target of Chinese population policy.

Figure 2 shows the changing age distribution that would result from the 'zero population growth' total fertility rates of Fig. 1. The curve that declines smoothly from left to right represents the age distribution for 2001, just before zero population growth begins. The three jagged curves represent the projected age distributions for 2021, 2041, and 2061, which peak from left to right.

The social stresses that would result from such a radical and sustained distortion of age structure can only be guessed, but these would likely be as great as the stresses imposed by continued population growth. The combination of this consideration and the improbability of achieving such rapid fertility decline effectively rule out an early realization of zero population growth.

Scenario III: Smooth approach to zero growth

On a very general consideration, both a continuation of the current slow rate of fertility decline and zero population growth from 2001 forward are unsatisfactory. More rapid fertility decline, but not too rapid, will evidently be in the best interest of the country and its people. This general notion can be made more specific by considering a third scenario for future population growth in which growth is minimized subject to reasonable conditions on changing age distribution.

Standard population projections work forward from an observed initial age distribution and assumed future levels of fertility and mortality to implied future age distribution and total population. The 'zero population growth' projection of the preceding section inverts this procedure by stipulating what population growth is to be, and then ascertaining what levels of fertility are required to yield this growth.

A similar procedure is applied here, but instead of requiring total population to be constant, we require that the number of persons aged 0-4 year(s) be constant beyond 2001. This results in a smooth approach to zero population growth in the future, with no disruption of age distribution. Population growth is minimized subject to the condition that future age distributions never have fewer persons in younger age groups than in older age groups.

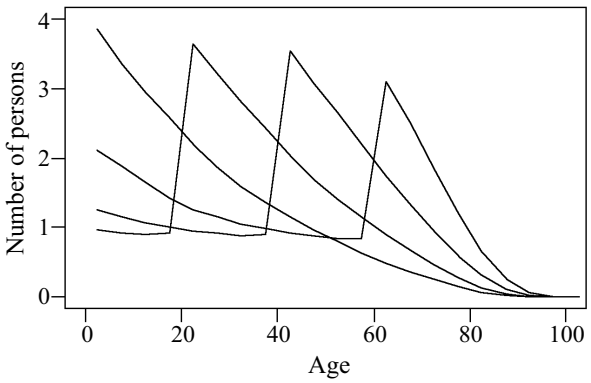

Fig. 2. Changing age distribution implied by zero population growth in Nepal following 2001. The smooth line represents the age distribution in 2001. The three peaked lines represent the age distributions in 2001, 2021, and 2041 (left to right)

Figure 3 shows the total fertility rates required to effect this change. The level of fertility declines from 4.8 children per woman for 1996-2000 to 2.7 children per woman for 2016-2020, a rate of decline slightly over one child per woman per decade. Figure 4 shows the resulting population growth (solid line) together with the census counts for 1911 through 1991. Perhaps disappointingly, population increases to 56 million before stabilizing *circa* 2075. This growth is due entirely to the

'filling out' of the age distribution that occurs with the approach to stationarity. Population momentum due to an increasing number of young persons has, by

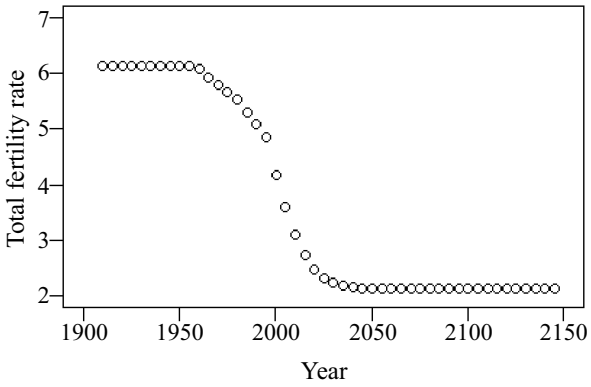

Fig. 3. Total fertility rates in Nepal under Scenario III (smooth approach to zero population growth)

construction, been eliminated. This is illustrated in Fig. 5 which shows age distributions at the same 20-year interval as in Fig. 2—2001, 2021, 2041, and 2061.

Scenario IV: More rapid fertility decline

The rate of fertility decline in Scenario III is substantially faster than Nepal has experienced in the recent past, but it is also considerably slower than the declines that have been observed in several other countries. It is, therefore, appropriate, without making any strong judgement as to the plausibility of more rapid decline for Nepal, to consider a scenario in which fertility declines more rapidly than it does in Scenario III. Because of the way in which Scenario III was constructed, some distortion of the age distribution will necessarily result from any more rapid fertility decline. It may be, however, that a moderately-distorted age distribution is a reasonable cost for lower growth.

Scenario IV assumes that the number of persons aged 0-4 year(s) declines, by 2016, to 70% of the number observed in 2001 with the number of persons aged 0-4 year(s) in 2006 and 2011 equal to 90% and 80%, respectively, of the number in 2001. This implies the total fertility rates of 3.7 children per woman for 2001-2005, 2.8 children per woman for 2006-2010, and 2.2 children per woman for 2011-2015, with near replacement-level fertility thereafter. This represents an average rate of decline of 1.8 children per woman per decade—extremely rapid—but within the range of observed experience in other countries.

The resulting age distributions, for the same years as shown in Fig. 2 and 5, are shown in Fig. 6. The gains in reduced population growth from this modest distortion in the age distribution are substantial: population rises to 40 million rather than to 56 million of Scenario III.

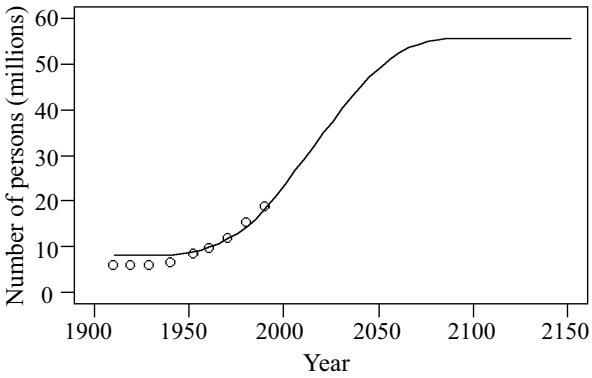

Fig. 4. Population growth in Nepal under Scenario III (smooth approach to zero population growth)

Can birth-timing overcome population momentum?

Since the early work of Ryder on the relation between period and cohort measures of fertility, it has been recognized that period-fertility may fall temporarily below cohort-fertility if age-at-childbearing rises and may rise temporarily above cohort-fertility if age-at-childbearing falls. The magnitude of the possible effects

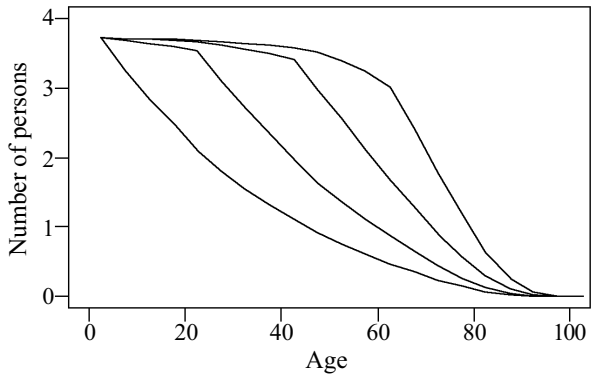

Fig. 5. Changing age distribution in Nepal under Scenario III (smooth approach to zero population growth). The lines represent age distributions in 2001, 2021, 2041, and 2061 (left to right)

is surprisingly large. A rise in mean age-at-childbearing of only one-tenth of a year per year, for example, can depress the level of fertility by 10%.

It has been suggested recently that this phenomenon may provide a way of overcoming population momentum (8). The scenarios presented in the preceding section show

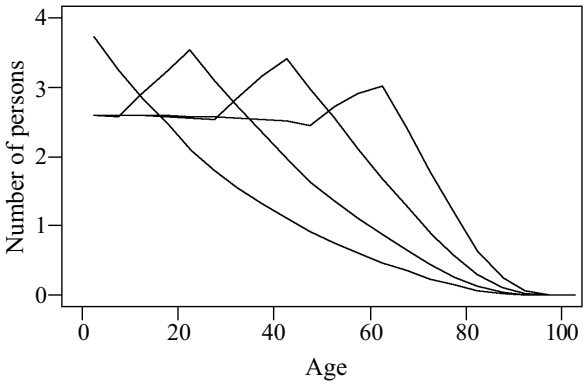

Fig. 6. Changing age distribution in Nepal under Scenario IV (some distortion of population age distribution). The lines represent the age distributions in 2001, 2021, 2041, and 2061 (left to right)

that this is both true and false. This is true in the sense that substantial rises in age-at-childbearing change the meaning of a rapid decline in period total fertility rates, so that a very rapid decline in these rates corresponds to a much more modest decline in the number of children the families have. Were the mean age at childbearing in Nepal to increase sufficiently, with or without encouragement from a formal policy, the rapid fertility declines in Scenario III and IV become much more plausible than they would otherwise be.

The "zero population growth from 2001 forward" scenario (Scenario II) shows, however, that rapid fertility declines are only half of the problem. The other half is the distortion in the population age distribution that results when zero population growth is forced too quickly. How much distortion can a society tolerate, and how much does this constrain a rapid approach to zero growth?

A comparison of Fig. 2 and 6 indicates the issue in raw numerical terms. On the one hand, the distortions of Fig. 2 appear far too severe to contemplate. The gentler distortions of Fig. 6 might be considered tolerable. Indeed, the relatively smaller number of children and the relatively larger number of persons at working age during the first several decades might be salutary, and the overhang of older persons in the more distant future be manageable.

It is not immediately clear how to move beyond these very superficial assessments. Substantial and sustained declines in the number of persons entering the various levels of the educational system and the workforce would surely have important consequences, but more specific conclusions would require a combination of research and speculation on which we have very little experience. Speculation will be important, because no national populations in recent centuries have experienced age distribution changes anything like those depicted in Fig. 6, much less than those depicted in Fig. 2.

Can changes in birth-timing overcome population momentum? Literally understood, the answer must certainly be 'no.' Even if birth-timing could affect the rapid fertility decline depicted in Fig. 1, which is conceivable as a general proposition (if perhaps very improbable for Nepal), the resulting changes in age distribution would almost certainly be unacceptable.

Clearly, the proper question is not whether, but to what extent, birth-timing can ameliorate population momentum. Scenario IV provides an answer to this question. On the one hand, it is most unlikely that fertility decline in Nepal will proceed any more rapidly than this (probably many would say that this is far too rapid). On the other hand, population under this scenario still becomes more than double over the next 50 years. We conclude that rapid increases in age at childbearing might, in this case, reduce the effect of population momentum to a mere doubling of population. It is most unlikely to accomplish more than this.

CONCLUSION

We set out to study demographic transition in Nepal in broad historical perspectives. What have we learnt? We have evidence, necessarily rather tenuous in view of the limited statistical data for the first half of the current century, that mortality decline began from a very high level during 1930s. Contemporary statistical data indicate that fertility decline has begun probably during 1970s. It has not yet proceeded very far, but provides some basis for extrapolation of future declines.

The greater part of this portrait of Nepal's demographic transition consists accordingly of speculations about possible futures. We have made no effort to forecast future fertility levels, but have, indeed, inverted the usual process of population projection by using it to see what future trajectories of fertility would be required to generate certain population figures.

The four scenarios of future fertility decline and population growth that we have presented help draw several conclusions. A continuation of the recent slow pace of fertility decline would result in a total population of slightly over 100 million by the end of the century (Scenario I). More rapid decline, similar to the median experience of Asian countries, would reduce this growth to below 60 million (Scenario III). Still more rapid decline, close to the limit of what has been observed in countries that have experienced the most rapid declines, could reduce the growth to 40 million (Scenario IV).

It is possible, if not at present particularly plausible, that very rapid decline might be achieved by a combination of smaller family sizes and rising age at childbearing. An approach to reaching zero population growth rapidly—and anything less than a doubling of current population—may be ruled out with a high degree of certainty (Scenario II and IV).

Considered individually, the four scenarios have no predictive values. Taken together and in the context, however, they point to a prediction that may be advanced with considerable confidence: the population of Nepal will at least double over the next century. No conceivable fertility decline can prevent this, whether or not induced to some degree by increasing age at childbearing. Only catastrophically high mortality levels could prevent this future growth, which results from the momentum of the current young-age distribution.

It should be emphasized, however, that a doubling of population to 40 million is the least possible growth that can be expected. At the current rate of fertility decline, population will increase to 100 million over this century. If a smaller population in this range is considered to be in the national interest—as most would probably assume—it is as important to work for more rapid fertility decline as it is to work for the accommodation of a much larger population.

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